DENSITY OF SYSTEMS (ETHYLENGLICOLY+WATER+HYDRAZINE) AT THE PRESSURE AND TEMPERATURE.

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ABSTRACT.

The results of the experimental research on the thermodynamics properties (density, energy free, general energy Gibbs, energy Helmgols, inside pressures, temperature coefficient volume) systems ethylehglicoly+water+ hydrazine in the temperature range 293-573K, and pressure range P = 0,101-98.1 MPa, are presented. The density of the studes objects in the interval temperature (293-573) K was measured in the device designed and constructed by Guseynov K.D. and Bayramov N.M. (1985). The common relative errors of measurements in density, heat capacity, under a coefficient of confidence, α, of 0,95 are receptivity 0,1%.

INTRODUCTION.

For the calculation of heat and mass exchange and the development of mathematical model of the processes taking place in different reactors, we need data on the thermodynamics properties (density, Gibbs energy, Helmgols energy, enthalpy, entropy et. c.) of sample ethers in dependence temperature. In this paper, we have determined the intermolecular potential (including square well, Lennard – Jones, Kihora, Stockmayer) parameters from PρT and sound speed data for liquids ehylenglycoly ,water and hydrazine. The experimental data used was careful selected from many references [1-6]. After we get the intermolecular potential parameters, we used it to calculate the second viral coefficient and third viral coefficient. The second viral coefficient calculated from sound speed. In the paper end, we use method of molecular dynamics to research the viscosity of liquids systems ethylenglicoly+water+hydrazine. After processing and analysis of the experimental data on molecular heat capacity of the systems (Ethylenglicoly+Water+Hydrazine), we obtained the equation. We investigated the thermodynamics properties of the solutions (consentretions water ranger n= 0.1- 0.9 mol.) in the temperature range (293-573)K and pressure range P= 0,101-98,1MPa.

THEORY.

The molar volume of a mixture of components, v, in terms of the mole

fractions X_i and partial molar volumes of the components V_i is

$$V= \sum_{i=1}^{c} X_i V_i \qquad (1)$$

For an ideal solntion, the partial molar volumes equal the molar volumes of the pure liquid components. Denoting component the main components as 1 and the impurities as >1, the volume becoms:

$$V=X_1 V_1 + \sum_{i=1}^{c} X_i V_i \qquad (2)$$

Then using , $\qquad \rho=M/V \qquad (3)$

and the molar mass of the mixture :

$$M= \sum_{i=1}^{c} X_i M_i \qquad (4)$$

and assuming that the X_i are small for $i>1$, then

$$\rho= \rho_1/\omega_1(1-\rho_1 \sum_{i=2}^{c} \omega_i v_i) \qquad (5)$$

where $v_i=V_i/M_i$ are partial specific volumes of the impurities and ω_i is the mass fraction of component i.

Finally,the density of the mixture is related to the density of the main component and the impurities i by:

$$\rho= \rho_1/\omega_1(1-\rho_1 \sum_{i=2}^{c} \omega_i / \rho_i), \qquad (6)$$

The observed value of the density of a sample is sometimes presented as evidence of its purity. Ass uming the sample contains a single impurity, equation (6) can be solved for $\rho- \rho_1$:

$$\rho- \rho_1= \rho_1(1- \omega_1- \rho_1\omega_2/ \rho_2)/ \omega_1 \qquad (7)$$

EXPERIMENTAL.
DENSITY.

  Density measurements were made on the improved experimental device by the method of hydrostatic weighing (Guseynov K.D. and Bayramov N.M.

1985)[7]. The temperature was measured by means of a thermometer of resistance of type PTC-10, with the use of potentiometer of type U709. Pressure was measured by means of loaded – piston manometer, of type MP -2500, of accuracy class 0,005.

During analysis and processing of the experimental data of ethylenglycoly+ water+hydrazine as a function of temperature and pressures, we obtained the following equation of state:

$$P = \sum_{i=0}^{2} a_i T^i \rho^2 + \sum_{i=0}^{2} b_i T^i \rho^8, \quad (8)$$

Where a_i and b_i are coefficients of the equation of state. With the help of equation (8) we calculated values of the coefficients of volume expansion (α_p), isothermal compressibility (β_T), inner pressures (P_i), difference of heat capacities (C_p-C_v), and thermal pressure of measurement objects by means of the following equations [7-9]:

Where C_p is the heat capacity at constant pressure, and C_v is the heat capacity at constant volume capacity at constant volume.

$$\alpha_\mu = \frac{1}{\rho} \left(\frac{\partial \rho}{\partial T} \right)_p = \frac{A^I(T) + B^I(T) \rho^6}{2A(T) + 8B(T) \rho^6}, (9)$$

$$\beta_1 = \frac{1}{\rho} \left(\frac{\partial \rho}{\partial T} \right)_\mu = [2\rho^2 A(T) + 8\rho^8 B(T)]^{-1}, (10)$$

$$P_i = \frac{\alpha_p}{\beta_T} T - P, \quad (11)$$

$$C_p - C_v = \frac{\alpha_p^2 T}{\beta_T \rho}, (12)$$

MOLECULAR HEAT CAPACITY.

An experimental device for measuring the specific heat capacity of ethylenglycoly + water+hydrazine was constructed according to the method of monotonic heating. The device consists of the measuring cell, recorder, Dewar vessel with melting ice, pressure vessel, loaded-piston manometer of type MP-2500, and electronic measuring instruments [10]. During temperature measurement we used a differential Chromel – Alumel thermocouple with a diameter of 0,15mm, the ends of which were connected to the recorder. The cold arm of the differential thermocouple was put into the Dewar vessel with melting ice, and the hot arm was touching the body of the toluene, n–hexane, and kerosene were made. The specific heat of the control patterns under atmospheric pressure was measured in the temperature range 273 – 373K. The results of the control measurements of the heat capacity of toluene, n – hexane, and kerosene coincide with published data, within the error limit of 2%.

$$\frac{C_p}{C_p^*} = f\left[\frac{T}{T_1}\right], \quad (13)$$

RESULTS AND DISCUSSION .

For generalize experimental data molecular heat capacity we use following law:
Where C_p^* - molecular heat capacity measurements objects at the $T_1 = 200K$ (liquids).

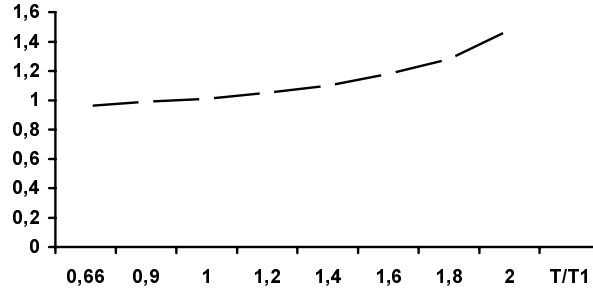Fig. 1, 2 presents molecular heat capacity C_n/C_n^* solutions at the temperature (T/T_1) and μ.

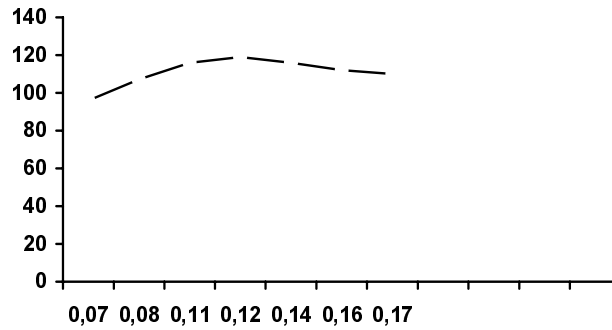Fig. 1. Dependence C_p/Cp^* at the T/T_1 for solutions.

Fig. 2. Dependence $C_p^* = f(\mu)$ for measurements objects .

After processing and analysis of experimental data on molecular heat capacity of the measurement objects, we obtained the following empirical equation:

$$C_p = \left[-2,91 \cdot 10^{-2}\left(\frac{T}{T_1}\right)^2 + 1,004\left(\frac{T}{T_1}\right) + 0,035\right] *$$

$$* (-6204,6\mu^2 + 1589,1\mu + 17,49), \frac{J}{mol \cdot K}, \quad (14)$$

Equation (14) can be used for the determination of the molecular heat capacity of measurements objects as function of temperature and molecul mass.

REFERENCES

1. Counsell J.F., Lee D.A., Martin J.F. – *J. Chem. Soe (A),* №2, (1971), p. 313-316.
2. Stall D., Vestram E., Zinke G. *Chem. Thermodynamics organic materials* // M.Mir, (1971) 944p.
3. Andon R. J. L., Martin J. F. – *J. Chem. Thermodynamics* (1975), v. 7. №6., p. 693 – 606.
4. Andon R. J. L., Counsell J.F., Lee D.A., Martin J.F. – *J. Chem. Soe*. Faraday Trans. I, v.70, №10, (1974), p. (1914 – 1917).
5. Andon R. J. L., Counsell J.F., Lee D.A., Martin J.F. – *J. Chem*. *Thermodynamics* v. 7., №6, (1975), p. 587 – 592.
6. Furukawa G.T., Ginnings D.C., Me Coskey R.E., Nelson R.A*. J. Res*. NBS, v.46., №3, (1961), p.195 – 206.
7. Guseynov K.D. Bayramov N. M. J. *Oil and Gas*, №3, (1985), p.39 – 44.
8. Guseynov K.D. *Dissertation of doctoral technical sciences*. Baku. (1979), 360 p.
9. Guseynov K.D. Bayramov N. M. J. *Oil and Gas*, №6, (1987), p.85.
10. Safarov M. M. *Doctor Dissertation d. t. s.* (Dushanbe, 1993). p. 495.